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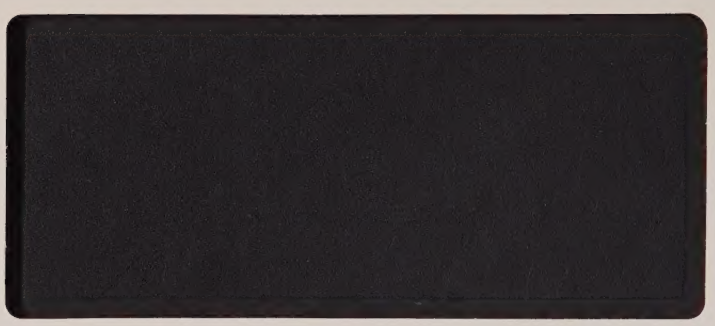
QTL

• ELECTRONIC INSTRUMENTS

Quan-Tech

LABORATORIES INC.

WHIPPANY, N. J.



INSTRUCTION MANUAL
MODEL 420
NOISE GENERATOR
for Serial No._____

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Quan-Tech LABORATORIES, INC.

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

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CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.
2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

A. DESCRIPTION

The Model 420 provides a convenient, stable, calibrated, white noise source for general laboratory applications. It provides an excellent constant amplitude per root cycle (equal power per cycle of bandwidth), and a good Gaussian amplitude distribution within the range specified.

Application includes the calibration of noise measuring equipment, random noise source to extremely low frequencies for vibration and strain analysis. When used in conjunction with scanning equipment it provides important information on the spectrum analysis of amplifiers, filters and other networks.

With the use of proper filters and networks the noise source may be used to reproduce the frequency and amplitude distribution of most waveforms encountered.

B. SPECIFICATIONS

Output Voltage:
.01 to 1000 microvolts per root cycle.

Output Attenuator:
600 ohm bridged "T" continuously variable and 5 position 10:1 constant impedance ladder type attenuator with switch to provide internal or external termination. Accuracy: ± 0.1 db per step.

Output Meter:
Logarithmic, scale calibrated 0.1 to 1.0 Accuracy: ± 0.5 db.

Output Frequency:
White (Constant amplitude per root cycle) D.C. to 100 KC. ± 0.5 db,

Output D.C. Offset:
Less than 10 millivolts at maximum output.

Amplitude Distribution:
Normal (Gaussian)

Power:
117/234V 50-400 CPS approx. 10 Watts.

Physical Dimensions:
Case 12"w x 6"h x 8"d

Weight:
12 lbs.

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A. OPERATION

1. For initial operation of this instrument, connect line plug to a suitable source of power, see voltage plate at rear of instrument just above the power cord. If voltage other than that indicated is desired, consult Page 4-1 for conversion instructions.
2. Turn power switch to ON position and advance the VARIABLE attenuator clockwise. The NOISE meter should indicate this attenuator setting.
3. The output impedance of this generator is 600 ohms and the indicated output will be correct only when properly terminated in 600 ohms. An internal 600 ohm termination is available by setting the switch located next to the output terminals to 600Ω TERM position. This termination is satisfactory for all load impedances which are high compared to 600 ohms. For lower impedance loads proper matching attenuators should be used.
4. The instrument is now ready for use and the RMS output voltage will be the product of the meter indication, the METER MULTIPLIER and the square root of the noise bandwidth of the termination.

   EXAMPLE: The maximum calibrated output of the generator is as follows:

   Meter indication $(1.0\,uv/\sqrt{\sim})$ x METER MULTIPLIER (x 1000) x square root of the noise bandwidth $(\sqrt{140\,KC})$, therefore the total RMS noise output of the generator $1 \times 1000 \times 374\,uv = 0.374$ volts

A. GENERAL

1. The design of the Model 420 Noise Generator is straightforward and employs only transistors and solid state devices. Reference to the Block Diagram and Schematic Diagrams will enable the user to understand the following description.

B. POWER SUPPLY

1. Power is obtained from the secondary winding of T101. This is rectified and filtered by CR101, GR102, and C101 and applied to the collector of pass transistor Q105. Control of Q105 is obtained from the collector of Q103 which in conjunction with Q102 form a differential transistor pair. Q101 and Q104, a second differential pair, drive the bases of Q102 and Q103 respectively, the base of Q104 being referenced to the Zener reference diode CR103 and Q101 sensing the error voltage across the divider network consisting of R103, R104, and R105, the whole resulting in an extremely stable, low noise power supply of 20 volts.

C. NOISE SOURCE AND IST AMPLIFIER

1. The noise source is obtained from CR201 which is selected for stability, noise spectrum and amplitude distribution when operating in an avalanche condition. This noise spectrum is amplified by Q201 operating in a grounded emitter configuration with an unbypassed emitter resistor for gain stability. R207 is selected to bring the overall amplifier chain gain to approximately 30,000.

D. 2nd AMPLIFIER

1. Q202 and Q203 form a two transistor amplifier. Gain and frequency response are controlled by overall negative feedback maintaining flat response from 300 KC to above 600 KC. C206 is used to compensate the frequency response at the higher frequencies and L202 limits the gain at the lower frequencies. L201 and C202 filter the +20 volt supply to prevent high frequency interaction.

E. HI-PASS FILTER

1. The Hi-Pass Filter is a conventional two section constant K pi filter with cut-off frequency of 300 KC and 2200 ohm impedance. The noise spectrum below 300 KC is rejected. See FIG. 3-1 for a Typical Hi-Pass Filter Response Curve.

F. 3rd AMPLIFIER

1. This amplifier is similar to the 2nd Amplifier with the following exceptions. Base biasing resistor R301 and R302 form the termination for the 300KC hi-pass filter. T301 supplies collector voltage to Q302 and noise drive to the mixer.

G. MIXER

1. The Mixer is a two transistor balanced series switch. The switching rate is 500 KC. Random noise containing all frequencies in the spectrum 300 KC to 700 KC are chopped at a 500 KC rate, generating a random sum and difference frequency spectrum with a normal amplitude distribution containing all frequencies from DC to 200 KC and also containing the fundamental noise frequencies and some 500 KC chopping frequencies.

H. LO-PASS FILTER

1. The Lo-Pass Filter is a two section constant K pi filter with -3DB cut-off at approximately 140 KC and 600 ohm impedance. This filter attenuates all frequency components above 140 KC and has a flat frequency response from DC to 100 KC to pass the noise difference frequency spectrum generated by the mixer. Termination for this filter is maintained constant by using a 600 ohm bridged "T" variable attenuator and a 600 ohm matched impedance step attenuator to the output terminals. See FIG. 3-2 for a Typical Lo-Pass Filter Response Curve.

I. 500 KC OSCILLATOR AND BUFFER

1. The 500 KC Oscillator consists of a single NPN transistor Q402, in a tuned collector circuit. Base feedback is obtained from a separate low impedance winding on the tank transformer T402. A very "stiff" or high "C" tank is employed to insure excellent frequency stability independent of transistor parameters. The oscillator is further isolated from the mixer and noise amplifiers by the +20 volt supply filter consisting of L401, C401, and the buffer amplifier consisting of Q401. T401 in the collector of Q401 supplies collector voltage and forms a balanced isolation transformer to drive the mixer switches.

J. METERING CIRCUIT

1. The meter amplifier and meter rectifier will be discussed together. The amplifier is similar in operation to the previous amplifiers. Q501, an NPN transistor, drives Q502, a PNP type grounded emitter, which in turn drives Q503 and Q504 a complementary symmetry pair supplying a low impedance drive for the meter rectifiers CR501 and CR502. The noise signals are rectified and measured by M501, a 1 ma. logarithmic response suppressed zero type meter. The meter rectifier return is applied to the emitter of Q501 providing maximum negative feedback and linearity. CR503 is a forward conducting diode to protect the meter against overloads. R509 permits adjustment and calibration of the noise level. It will be noted that the full noise bandwidth is monitored. This, in conjunction with the relatively large time constant of C506, R510 and the meter resistance, permit relatively steady measurement of the random noise level. The meter circuit is calibrated to read the RMS value of the noise signal. It should also be noted that when all attenuator controls are in the maximum output position, that external loading of the output terminals with other than a 600ohm resistive network in the pass band below140KC may affect the noise level measured by the meter circuit, and standard impedance matching techniques should be employed if accurate level measurements are desired.

K. VARIABLE ATTENUATOR

1. Continuously variable output of the noise level is provided by AT601, a variable bridged "T" 600 ohm attenuator. Input and output impedance are essentially constant for any setting of the VARIABLE control. The meter circuit monitors the full bandwidth noise at the output of this attenuator.

L. METER MULTIPLIER (STEP ATTENUATOR)

1. Calibrated output levels are provided by a five position constant impedance ladder type attenuator. Voltage attenuation ratio's of 10:1 per step permit accurate level settings when properly terminated in 600 ohms.
2. A front panel switch permits either internal or external termination of the output.

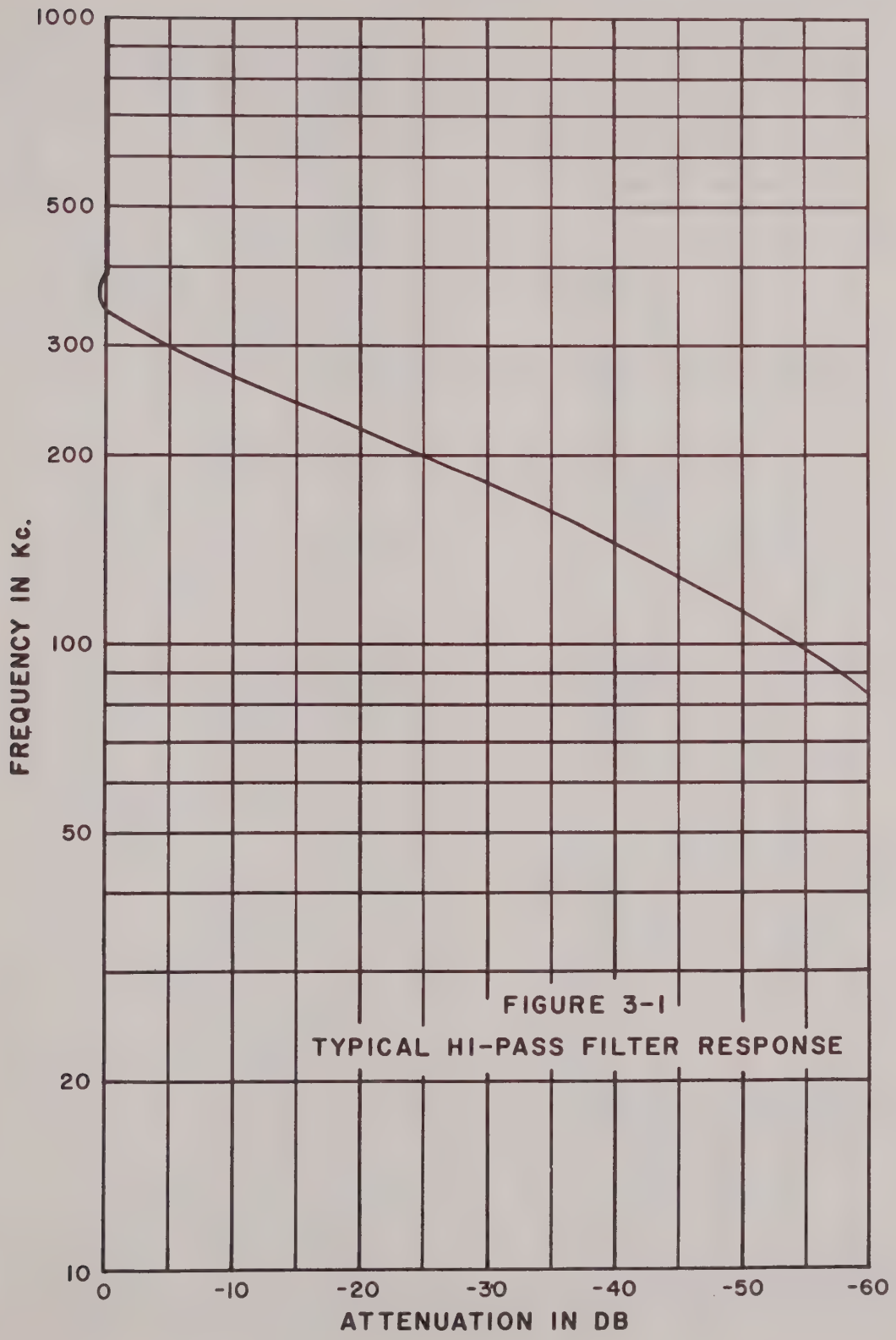


FIGURE 3-1
TYPICAL HI-PASS FILTER RESPONSE

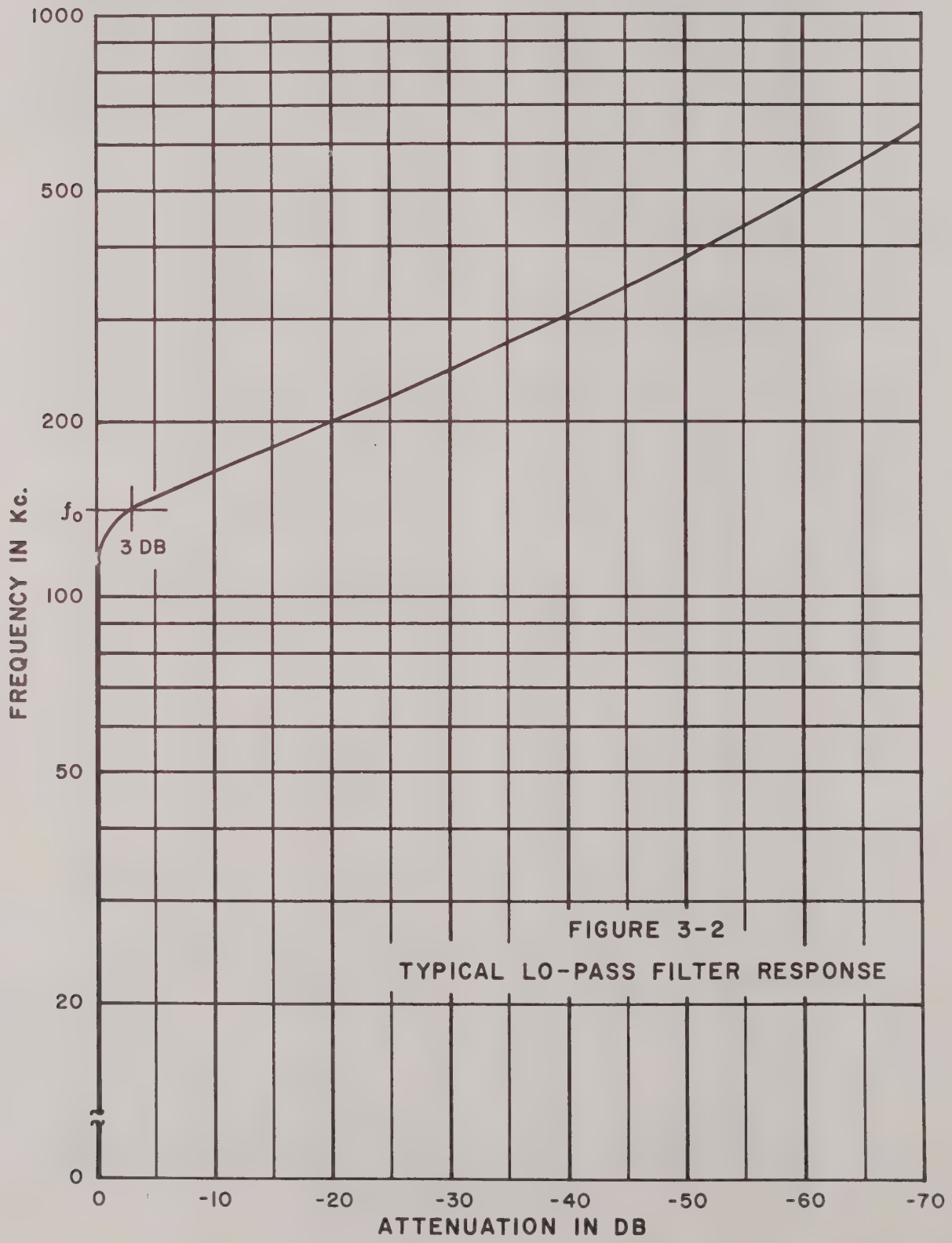


FIGURE 3-2
TYPICAL LO-PASS FILTER RESPONSE

A. GENERAL

1. The design of the Model 420 is straightforward, employing long life semiconductors, and preventive maintenance is therefore not required. Trouble shooting, if required, may readily be done in sections as indicated in the Block Diagram, Schematic Diagrams and Voltage Chart, FIG. 4.2. Standard transistor servicing care should be used throughout.
2. Do not change any adjustments without a thorough knowledge of the circuit and function of the adjustment.
3. The components and transistors in the Model 420 are conservatively rated and should provide long and trouble free service. If, however, the instrument has been damaged and recalibration or alignment is required, the following instructions should be followed explicitly, or the instrument should be returned to the factory.
4. Transistors can be easily damaged with large transient voltages, therefore, take great care not to short any terminals when making measurements on the printed circuit boards. In soldering to the boards, have the iron only hot enough to make a rapid clean solder joint. DO NOT apply any force which would tend to push the copper away from the board.
5. All voltage measurements may be made on the printed circuit connector board located on the bottom of the chassis. Refer to the Voltage Chart FIG. 4-2 for typical voltages for a normal instrument, variable attenuator control full clockwise.
6. It is advisable when removing any of the plug-in-units, to disconnect the line power and note carefully the location and direction of components when replacing. See FIG. 4-3, Plug-in Board Location.

B. REMOVAL OF INSTRUMENT FROM CASE

1. Remove the four No. 8 binder head screws from the rear of the case and gently slide the unit forward out of the case. It will be necessary to raise the handle during this removal process.

C. CHANGING THE INPUT VOLTAGE

1. This instrument has been designed to operate from a 117 V.A.C. or a 234 V.A.C. power source. The plate on the rear of the instrument near the power cord indicates the voltage and frequency at which the instrument should be operated. Should it be desired to change the input voltage proceed as follows:
   a. Remove the instrument from the case.
   b. Change the transformer primary connections by moving the jumpers on the 4 terminal barrier strip located on the bottom of the printed circuit module connector board. (See FIG, 4-2). Connect jumpers as indicated on FIG. 4-1.
   c. Reverse the plate on the rear of the instrument to indicate the new power source.

D. CALIBRATION

1. POWER SUPPLY
   Adjustment of the +20 volt supply is accomplished at the factory by selection of R105, and further selection should be unnecessary unless the Zener reference CR103 is replaced. 20 volts ±1 volt is satisfactory.
2. NOISE SOURCE
   From the top of the unit measure the DC voltage across the noise avalanche diode CR201 located at the top of the noise source plug-in board. Approximately 9 volts should be obtained. The noise output may be measured from the underside on Pin No. 4 and should be approximately that indicated on the Voltage Chart, FIG. 4-2. Care should be exercised when making these low noise measurements to eliminate hum by using a short, shielded, low capacitance cable and a vacuum tube voltmeter with a bandwidth of several megacycles.
3. NOISE AMPLIFIER
   The noise signal may be traced through the 2nd amplifier, hi-pass filter and 3rd amplifier using the preceeding method and standard signal tracing methods. Voltages should be approximately as indicated and noise display as indicated by a high frequency oscilloscope should show no signs of clipping on the noise peaks and be symmetrical about the center axis.
4. MIXER
   Analysis of the waveform of the mixer is rather difficult, but will appear as a random noise signal chopped at a 500 KC rate with an overall amplitude approximately as indicated on FIG. 4-2 Pin No. 1.
5. LO-PASS FILTER
   The accuracy of output level of the noise signal will depend on the bandwidth measurements of the lo-pass filter. These measurements may be made as follows:

a. Remove power from the instrument and remove the mixer plug-in board.
b. Connect a low impedance signal generator to a 450 ohm resistor connected to Pin #2 of the lo-pass filter. Approximately 2 volts RMS is satisfactory.
c. Set output termination switch to 600Ω TERM. position and with both the variable and step attenuators in their full clockwise position measure the output signal with a vacuum tube voltmeter at the output terminals. Approximately half the voltage used in Par. 2 above should be indicated.
d. Scan the frequency spectrum from 20 cycles to 200KC, maintaining the input signal constant and carefully note the -3 db filter cut-off frequency and flatness of the bandpass. The bandpass should be flat to 100KC and -3db at approximately 140KC.
e. Remove the signal and resistor from the connector board and replace the mixer plug-in board.

6. METER CALIBRATION

a. With the instrument operating, set attenuator controls as follows, VARIABLE attenuator full counterclockwise and METER MULTIPLIER full clockwise. This connects the meter amplifier input directly to the output terminals and the variable attenuator isolates the remainder of the circuitry.
b. Apply a sine wave signal to the output terminals at approximately 50 KC and adjust the signal level to 0.89 $x\sqrt{\text{Bandwidth}}$ x 1000 microvolts. (The bandwidth is that measured at the -3db point for the lo-pass filter. The correction factor 0.89 is that required when measuring noise with an average type detector calibrated to read RMS).
c. Adjust R509 located on the meter rectifier plug-in board for a full scale meter indication. This adjustment is available through an access hole in the chassis side plate. If a true RMS voltmeter with a bandwidth in excess of 150 KC is available it may be used to calibrate the generator by direct measurement of the full bandwidth output noise which will be 1000 $x\sqrt{\text{Bandwidth}}$ x microvolts for full scale meter indication.

7. 500 KC OSCILLATOR AND BUFFER

The 500 KC Oscillator requires no alignment as it is fixed tuned to approximately 500 KC. The waveform may be measured at the tank tuning capacitor using an oscilloscope probe directly on capacitor C401, located on the oscillator plug-in board to ground. A sine wave of approximately 20 volts peak-to-peak should be observed. Alignment of the buffer tank may be made by tuning C402 for a maximum signal as indicated by an oscilloscope probe at C402 located on the buffer plug-in board to ground. This waveform should also be a sine wave of approximately 20 volts P-P amplitude but will show slight clipping on the wave peaks. The adjustment of this tank tuning is usually modified to minimize the residual DC component at the output terminals. A large capacitor across the output terminals will facilitate this adjustment but the buffer tank should not be detuned below 15 volts P-P amplitude at C402.

NOTE: The oscillator buffer shield must be in place when making the final adjustment of C402.

8. AMPLITUDE RESPONSE

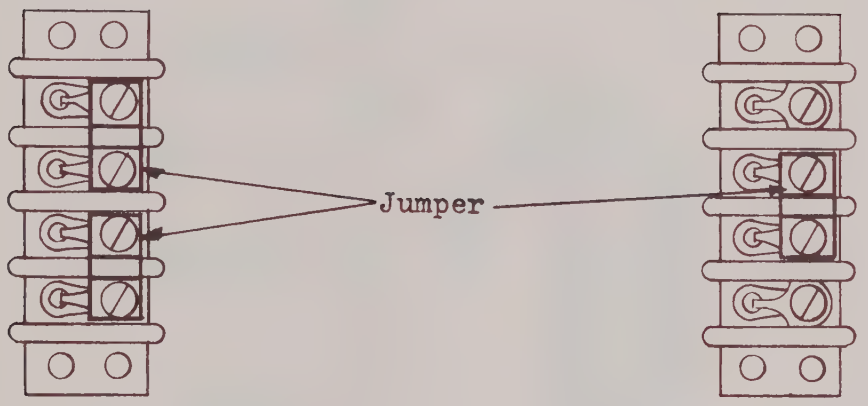
The flatness of the overall noise spectrum may be checked using a fixed bandwidth wave analyzer, similar to Quan-Tech Laboratories Model 303, and tuning from 30 cycles to 100 KC. C206 and C306 on the 2nd and 3rd amplifier plug-in boards may be adjusted to compensate the high frequency end of the spectrum.

9. MAXIMUM OUTPUT

After all the preceding adjustments have been made, the overall noise level may be adjusted by selection of R207 on the noise source and first amplifier board to obtain a noise level slightly above full scale meter indication when the variable attenuator is set full clockwise and the instrument is terminated in 600 ohms or the internal termination is used.

10. AMPLITUDE DISTRIBUTION

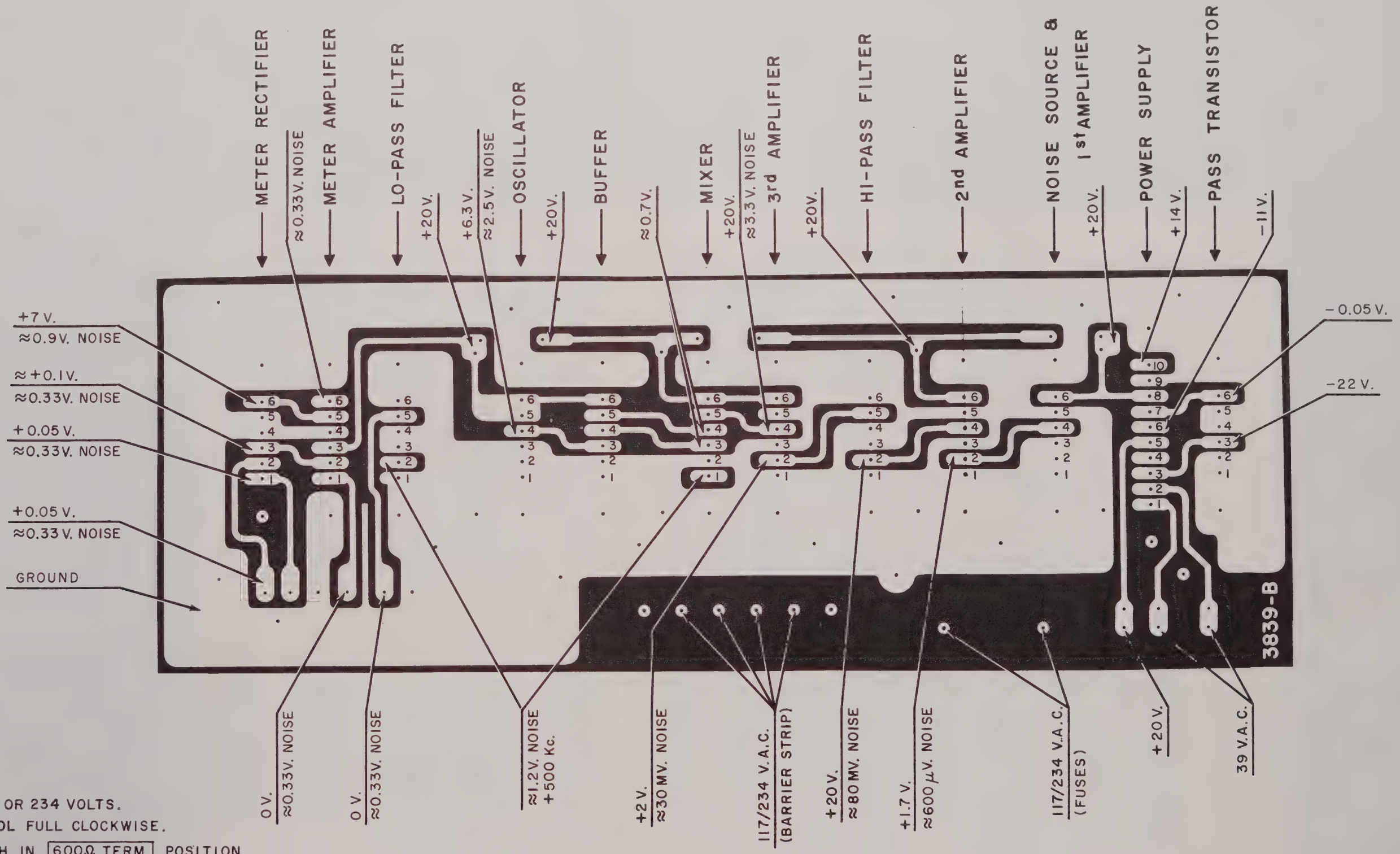
The amplitude distribution may be measured using an amplitude distribution analyzer similar to Quan-Tech Laboratories Model 317. See Figure 4-4 for a Typical Amplitude Distribution Plot.



For 117 Volt Operation

For 234 Volt Operation

FIGURE 4-1
INPUT VOLTAGE BARRIER STRIP



LINE VOLTAGE: 117 OR 234 VOLTS.
VARIABLE CONTROL FULL CLOCKWISE.
IMPEDANCE SWITCH IN 600Ω TERM. POSITION.
ALL VOLTAGES REFERENCED TO GROUND.
D.C. MEASUREMENTS MADE WITH A 20,000Ω/V. METER.
A.C. AND NOISE MEASUREMENTS MADE WITH A VTVM HAVING A BANDWIDTH >2 Mc.

BOTTOM VIEW OF CONNECTOR BOARD
FIGURE 4-2
VOLTAGE CHART

TOP VIEW OF MODEL 420

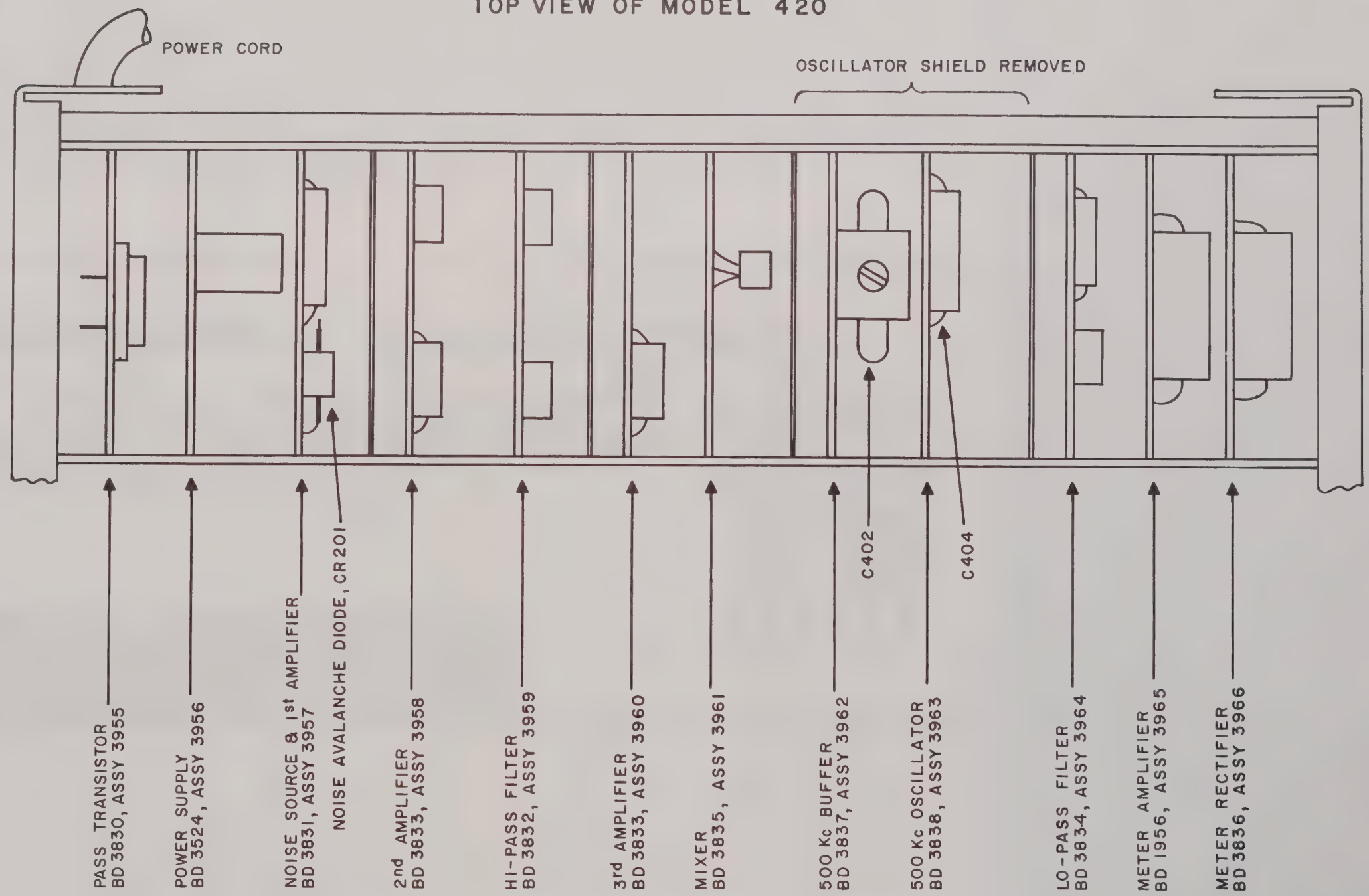

POWER CORD
OSCILLATOR SHIELD REMOVED
PASS TRANSISTOR BD 3830, ASSY 3955
POWER SUPPLY BD 3524, ASSY 3956
NOISE SOURCE & 1st AMPLIFIER BD 3831, ASSY 3957
NOISE AVALANCHE DIODE, CR201
2nd AMPLIFIER BD 3833, ASSY 3958
HI-PASS FILTER BD 3832, ASSY 3959
3rd AMPLIFIER BD 3833, ASSY 3960
MIXER BD 3835, ASSY 3961
500 Kc BUFFER BD 3837, ASSY 3962
C402
500 Kc OSCILLATOR BD 3838, ASSY 3963
C404
LO-PASS FILTER BD 3834, ASSY 3964
METER AMPLIFIER BD 1956, ASSY 3965
METER RECTIFIER BD 3836, ASSY 3966

FIGURE 4-3
PLUG-IN BOARD LOCATIONS

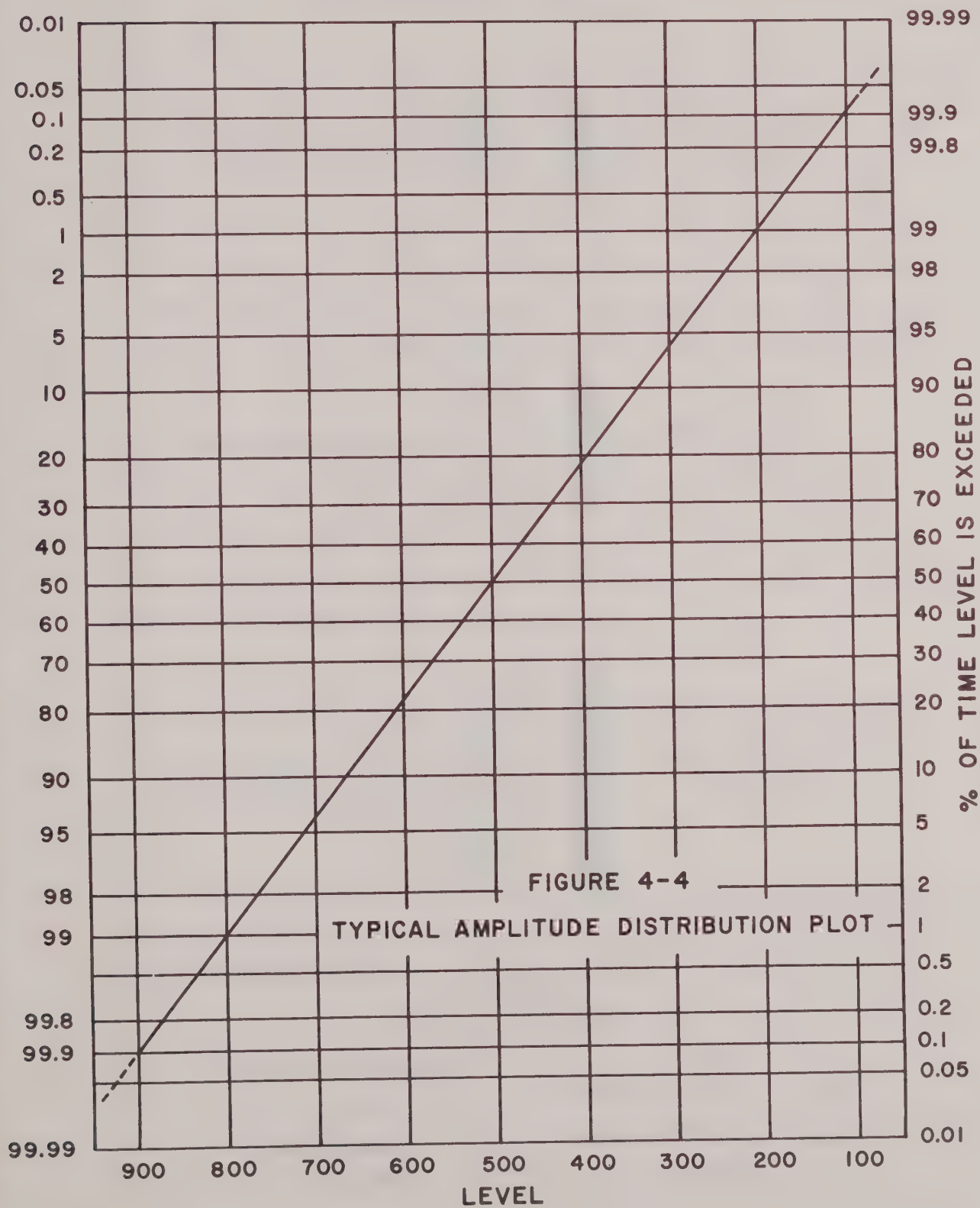
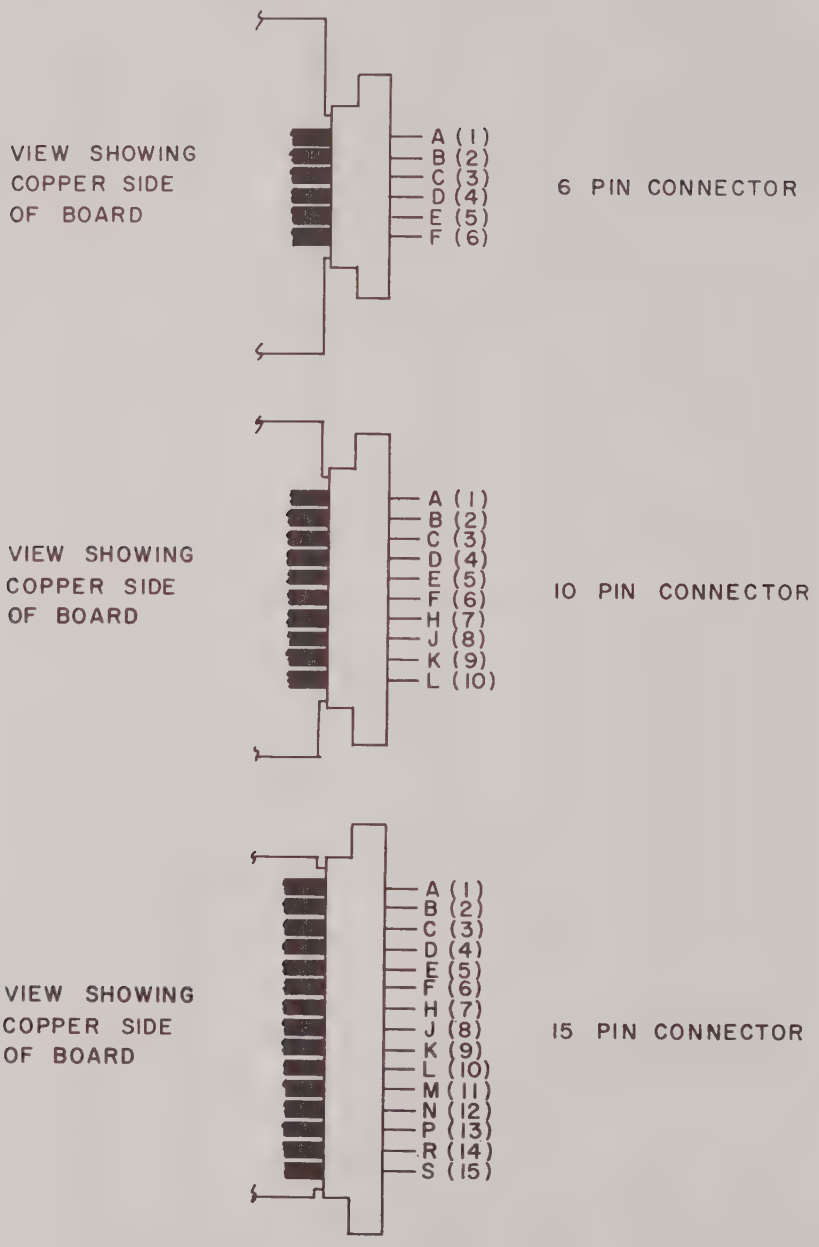


FIGURE 4-4
TYPICAL AMPLITUDE DISTRIBUTION PLOT



PRINTED CIRCUIT BOARD CONNECTOR LUG IDENTIFICATION

FIGURE 4-5

SCHEMATIC LEGEND

K = 1000

⊘ = Screw Driver Adjustment

▭ = Front Panel Control

* = Factory Select

Unless otherwise specified:

All resistances in ohms

All resistors ½ Watt

All capacitances in Microfarads

SEMICONDUCTOR LEGEND

Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

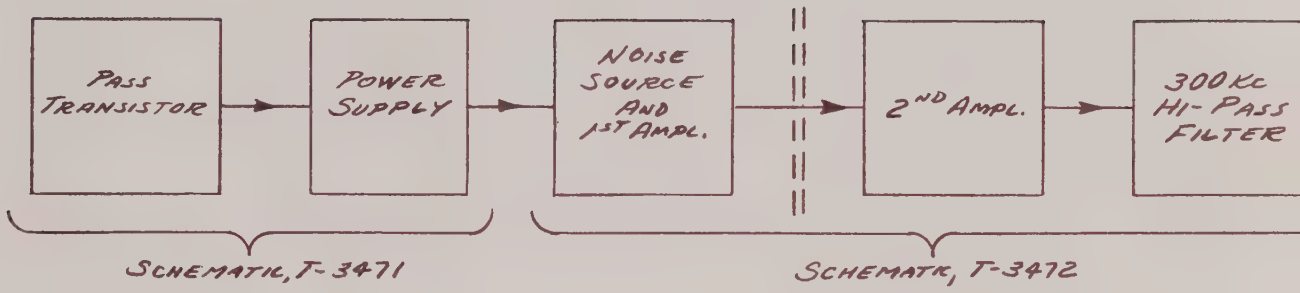
Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

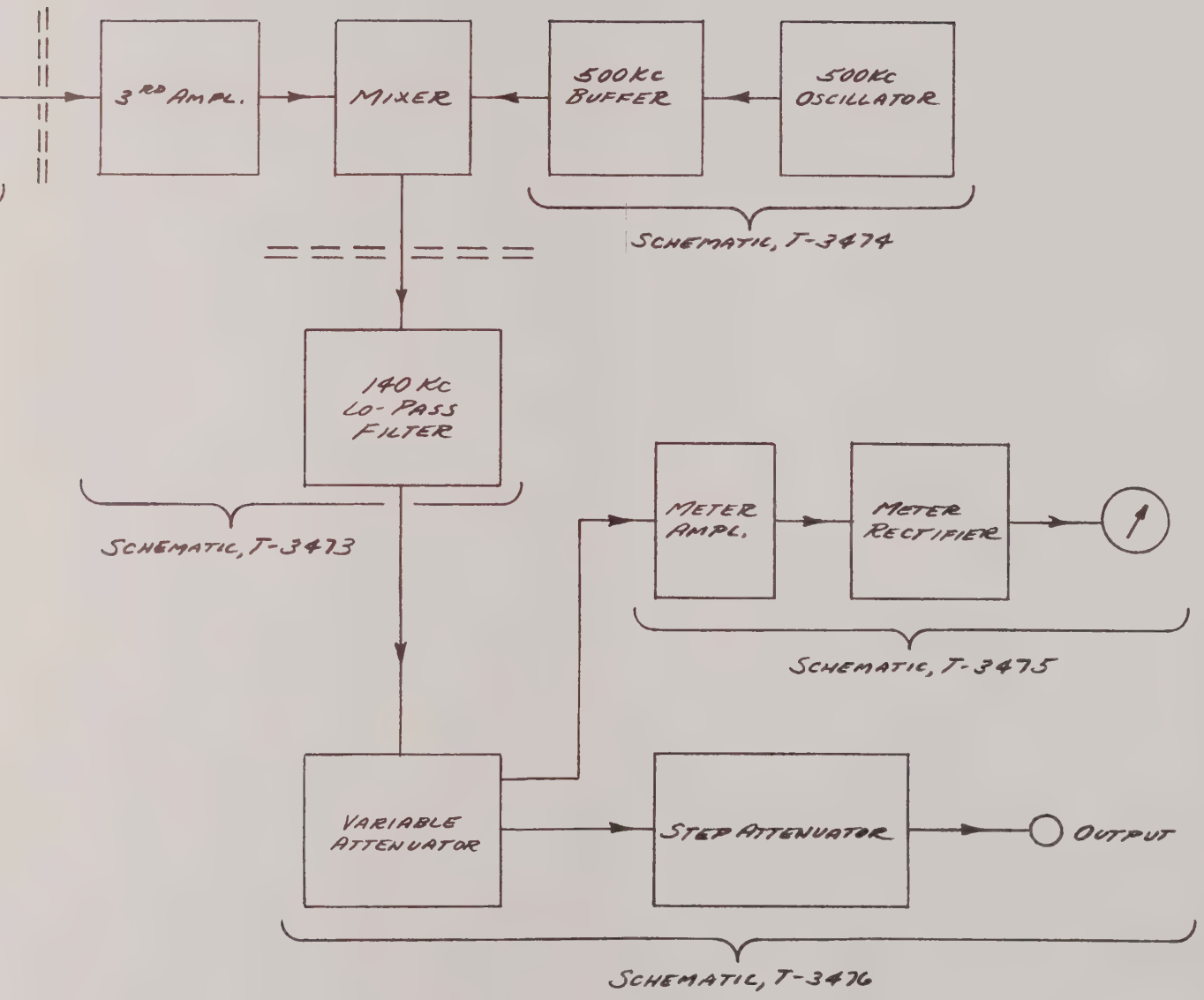
* It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

(OVER)

SEMICONDUCTOR LEGEND

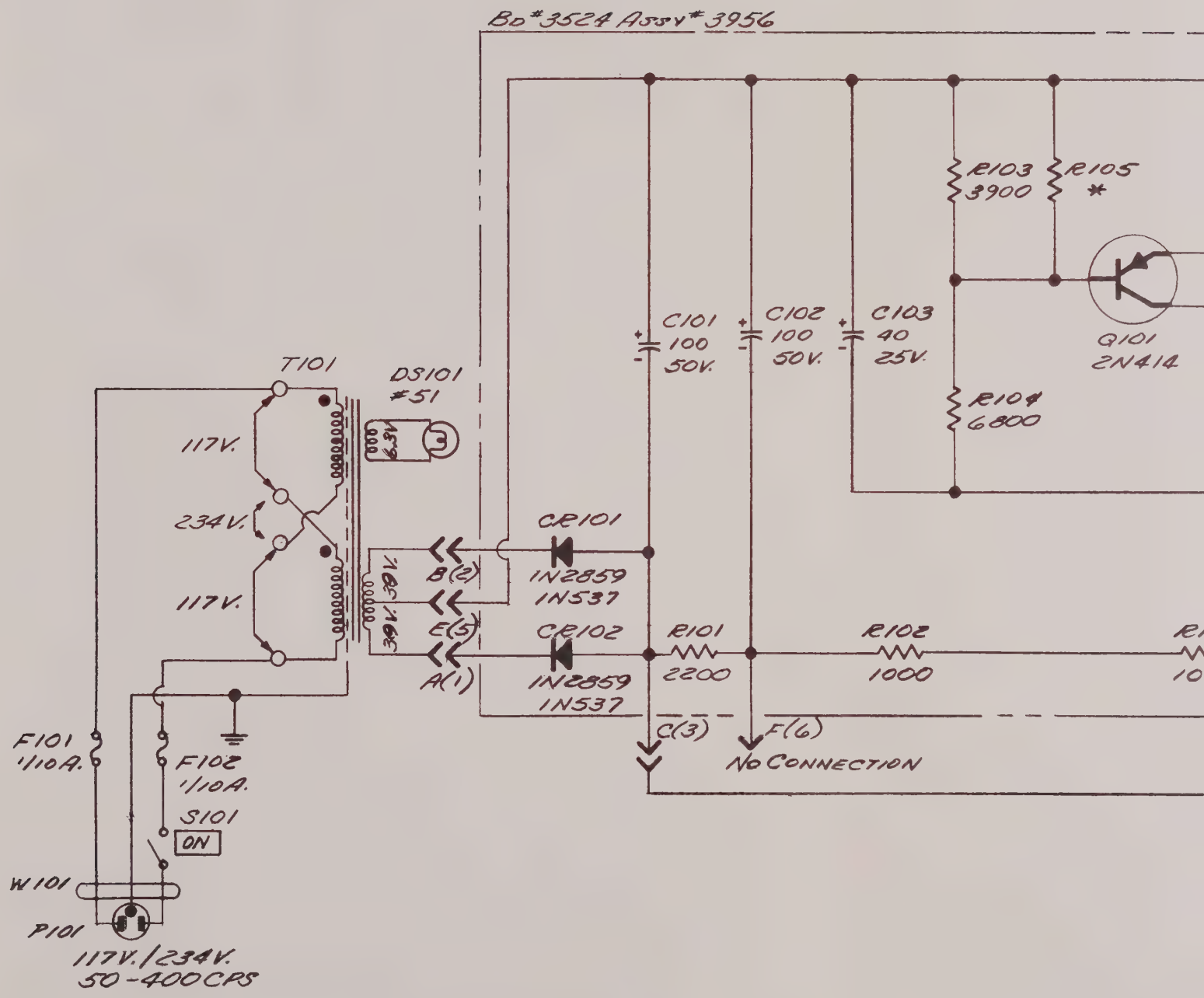
Type # on schematic	Type # in equipment
2N414	2N396A, 4JX1G759, 4JX1D653
2N396A	4JxlG759, 4JX1D653
T1480	2N1613
T1494	2N1613
2N2603	2N3250
2N929	220N2


PASS TRANSISTOR
POWER SUPPLY
NOISE SOURCE AND 1ST AMPL.
2ND AMPL.
300 Kc HI-PASS FILTER
SCHEMATIC, T-3471
SCHEMATIC, T-3472

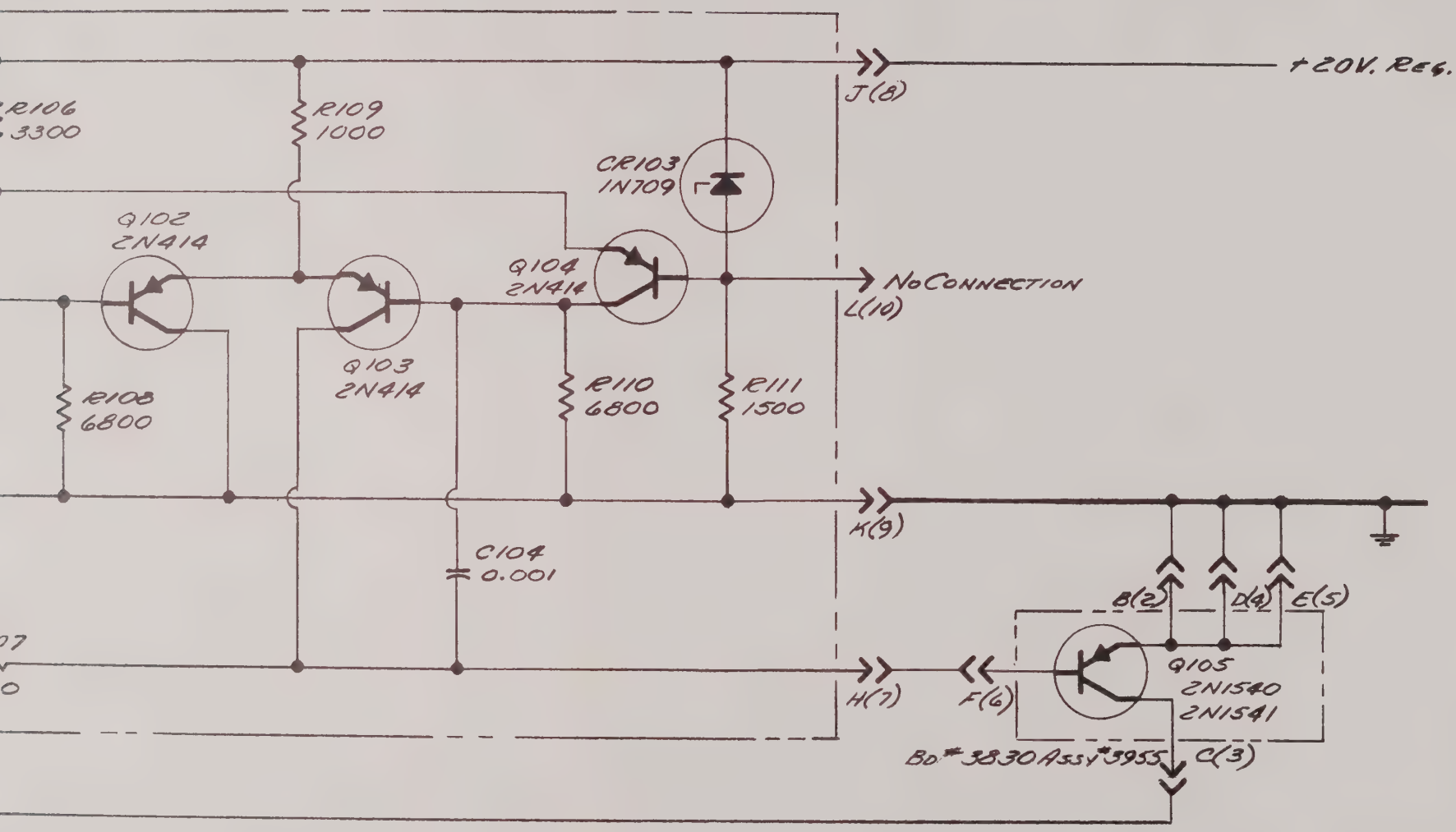


BLOCK DIAGRAM
NOISE GENERATOR
MODEL 420

B-3470-A

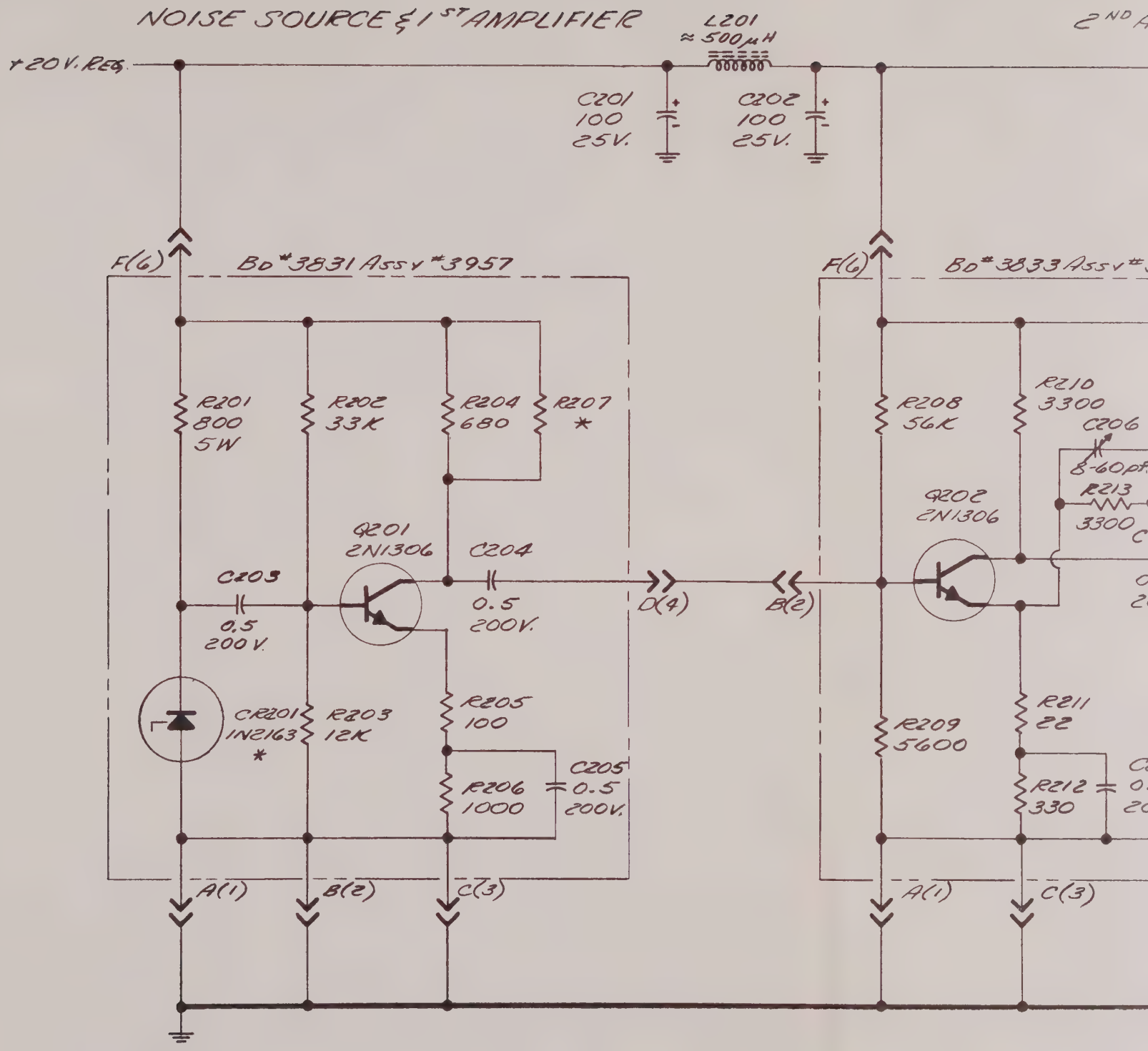

Bd #3524 Assy #3956
R103
3900
R105
*
C101
100
50V.
C102
100
50V.
C103
40
25V.
Q101
2N414
R104
6800
T101
DS101
#51
117V.
234V.
117V.
CR101
IN2859
IN537
B(2)
E(5)
A(1)
CR102
IN2859
IN537
R101
2200
R102
1000
C(3)
F(6)
No Connection
F101
1/10A.
F102
1/10A.
S101
ON
W101
P101
117V./234V.
50-400CPS

SUPPLY



SCHEMATIC
POWER SUPPLY
MODEL 420

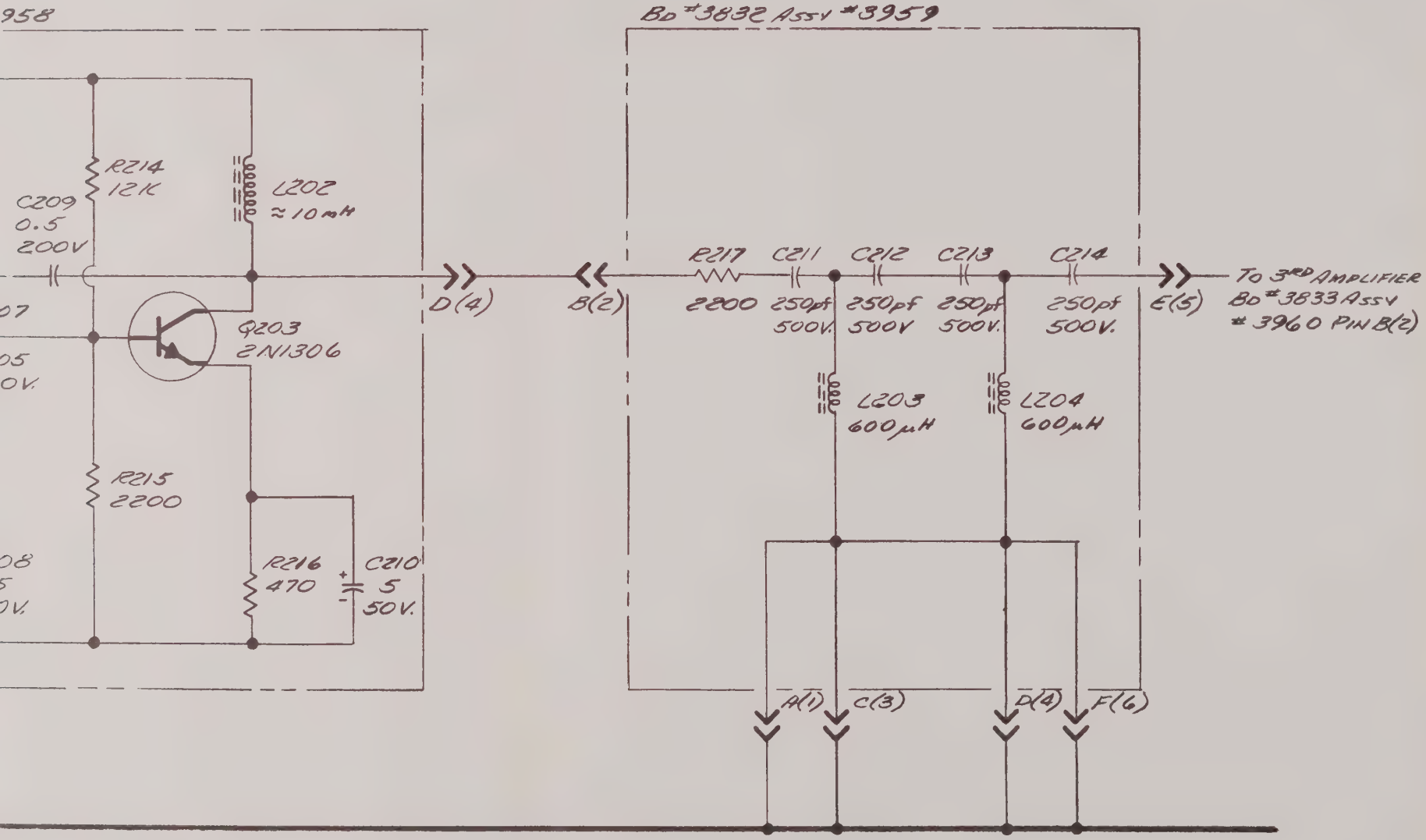
T-3471-A


NOISE SOURCE & 1ST AMPLIFIER
2ND A
L201
≈ 500 μH
+20 V. Reg.
C201
100
25V.
C202
100
25V.
F(6)
Bd #3831 Assy #3957
F(6)
Bd #3833 Assy #
R201
800
5W
R202
33K
R204
680
R207
*
R208
56K
R210
3300
C206
8-60pf
R213
3300
Q202
2N1306
Q201
2N1306
C204
C203
0.5
200V.
0.5
200V.
D(4)
B(2)
CR201
1N2163
*
R203
12K
R205
100
R206
1000
C205
0.5
200V.
R209
5600
R211
22
R212
330
A(1)
B(2)
C(3)
A(1)
C(3)

MPLIFIER

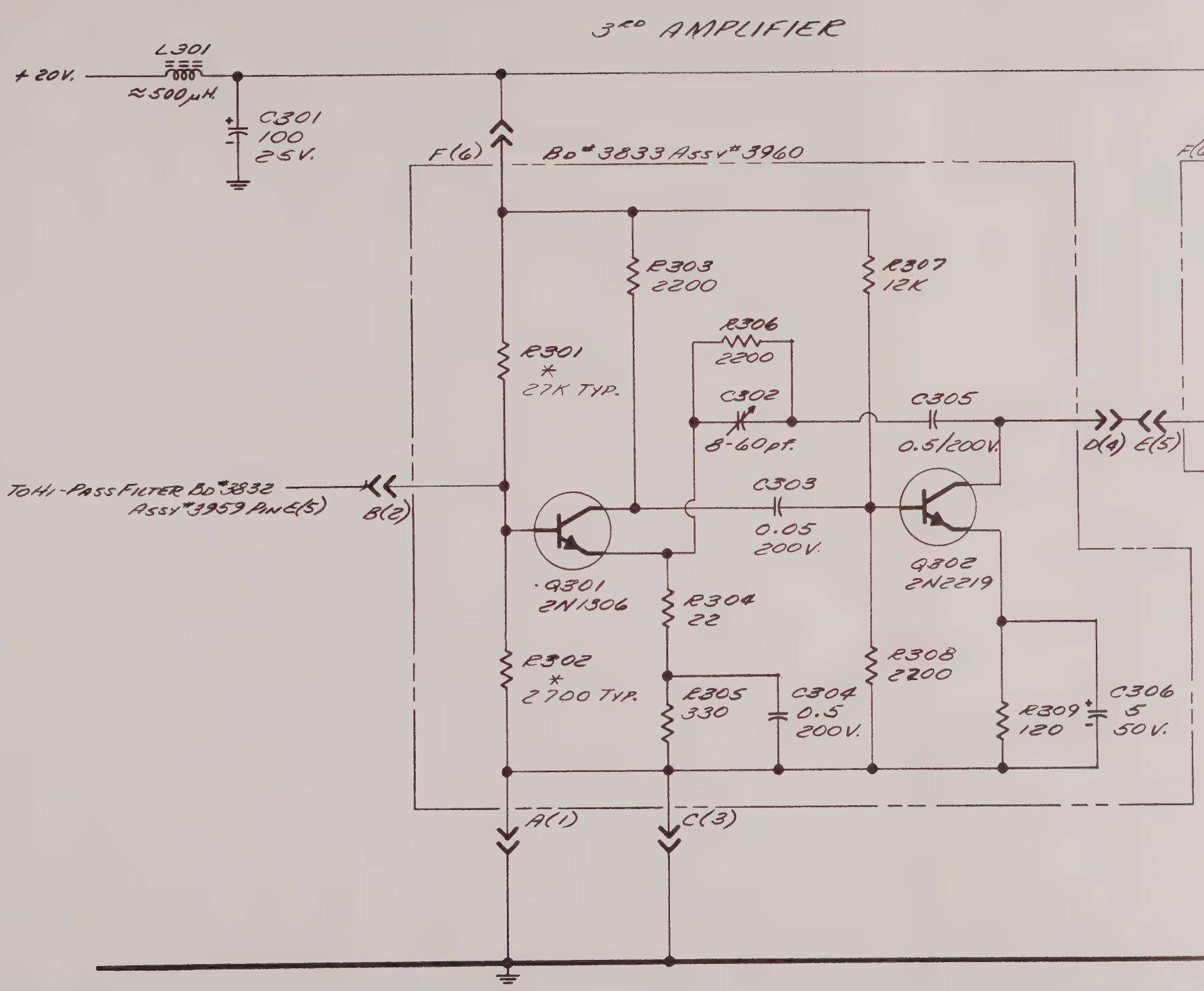
HI-PASS FILTER

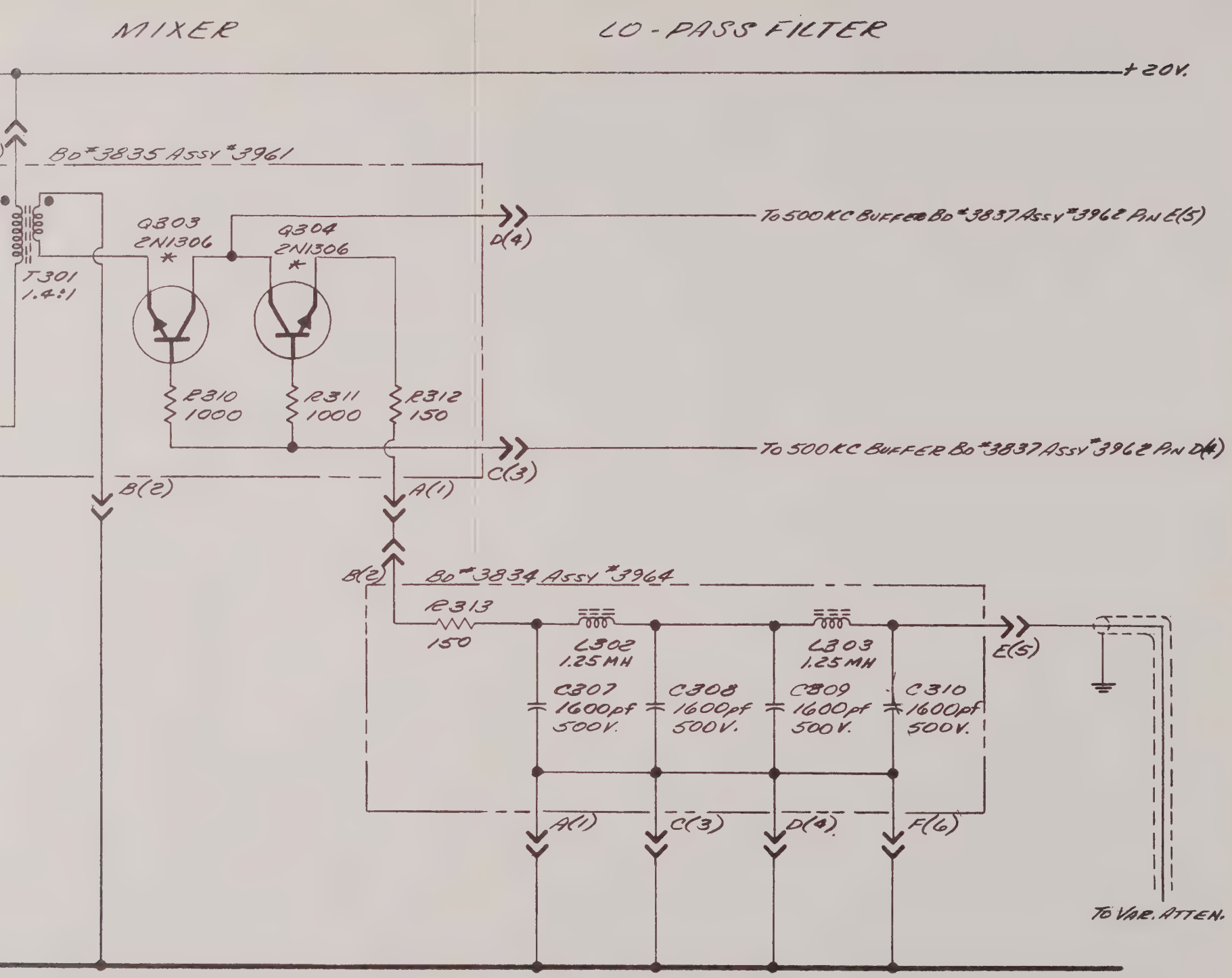
+20 V.



SCHEMATIC
NOISE SOURCE,
1ST AMPL., 2ND AMPL.,
HI-PASS FILTER
MODEL 420

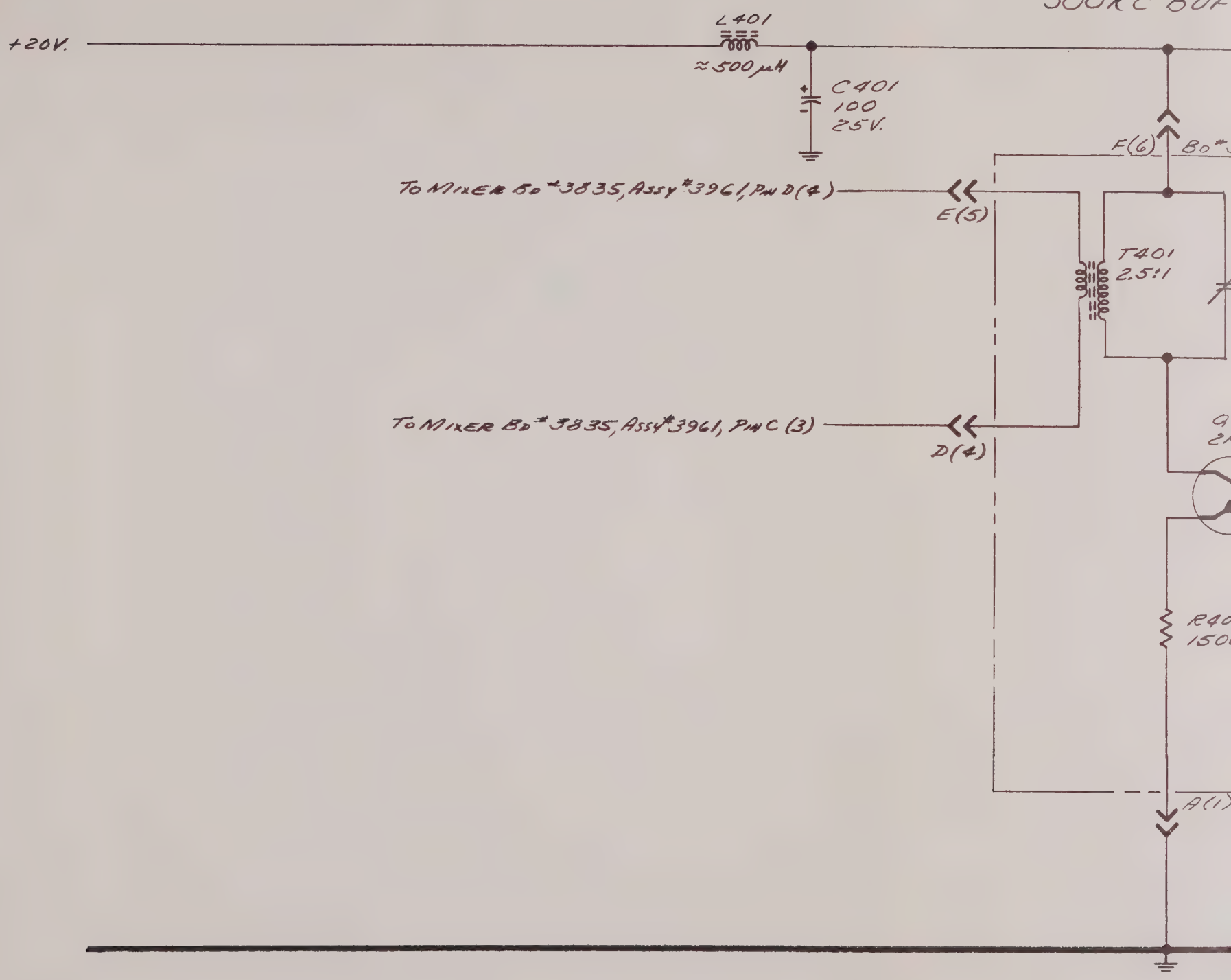
T-3472-A


3rd AMPLIFIER
L301
+20V.
≈500μH.
C301
100
25V.
F(6)
Bd*3833 Assy*3960
R303
2200
R307
12K
R306
2200
R301
*
27K TYP.
C302
8-60pf.
C305
0.5/200V.
D(4) E(5)
To Hi-Pass Filter Bd*3832
Assy*3959 Pin E(5)
B(2)
C303
0.05
200V.
Q301
2N1306
Q302
2N2219
R304
22
R302
*
2700 TYP.
R308
2200
R305
330
C304
0.5
200V.
R309
120
C306
5
50V.
A(1)
C(3)



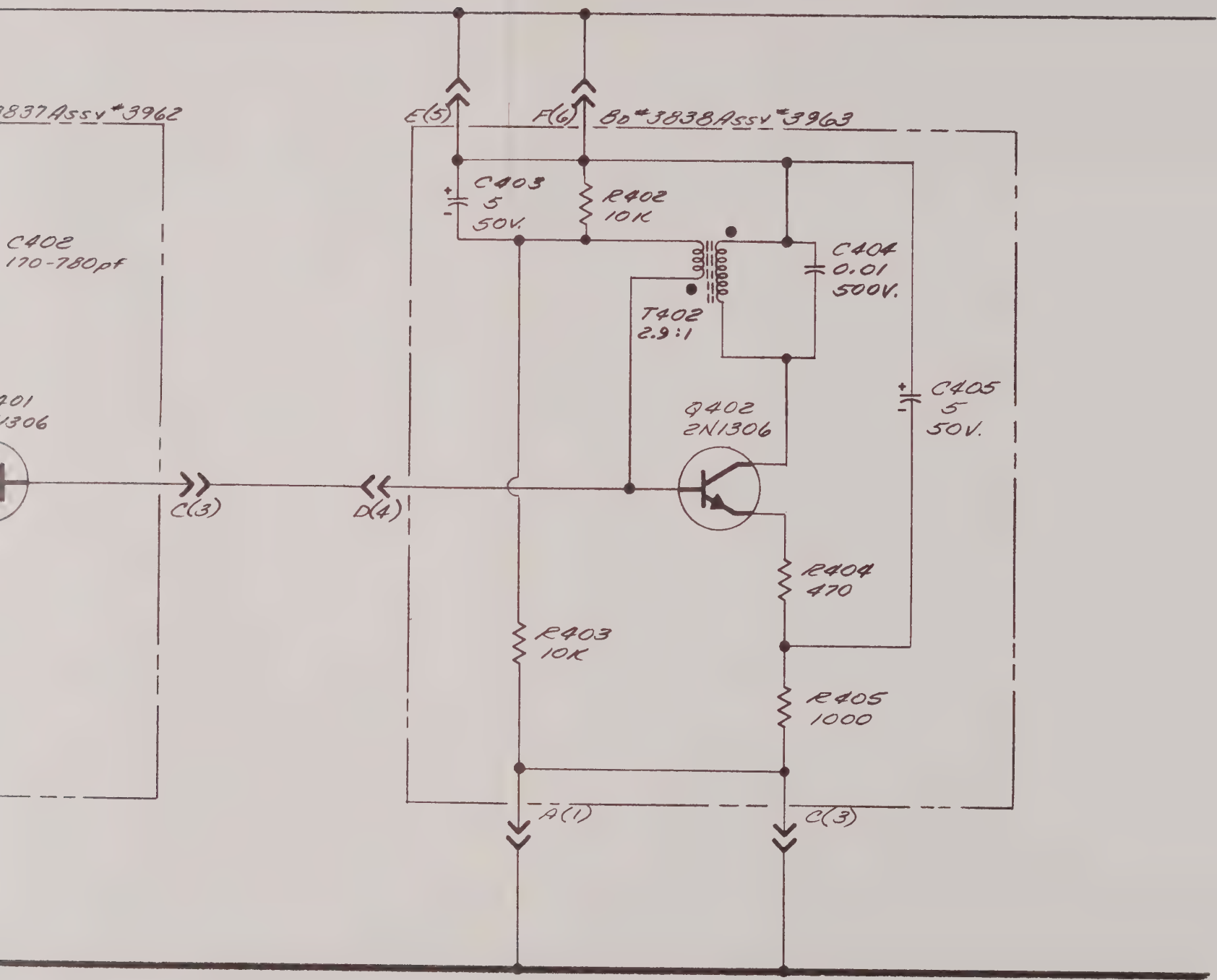
SCHEMATIC
3RD AMPLIFIER
MIXER
LO-PASS FILTER
MODEL 420

T-3473-B


500KC BUF
+20V.
L401
≈500μH
C401
100
25V.
F(6)
To Mixer Bd #3835, Assy #3961, Pin D(4)
E(5)
T401
2.5:1
To Mixer Bd #3835, Assy #3961, Pin C (3)
D(4)
A(1)

FER

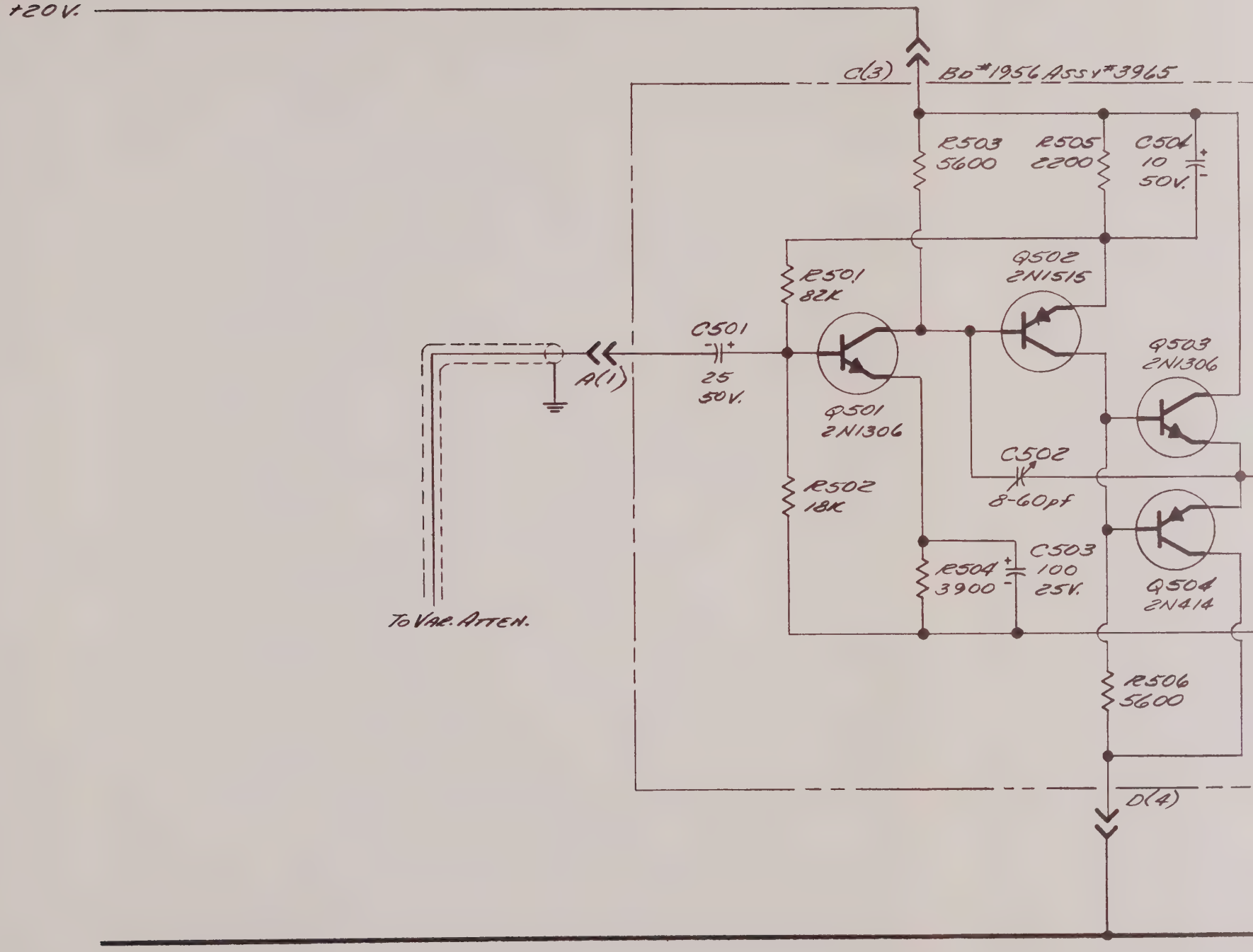
500KC OSCILLATOR



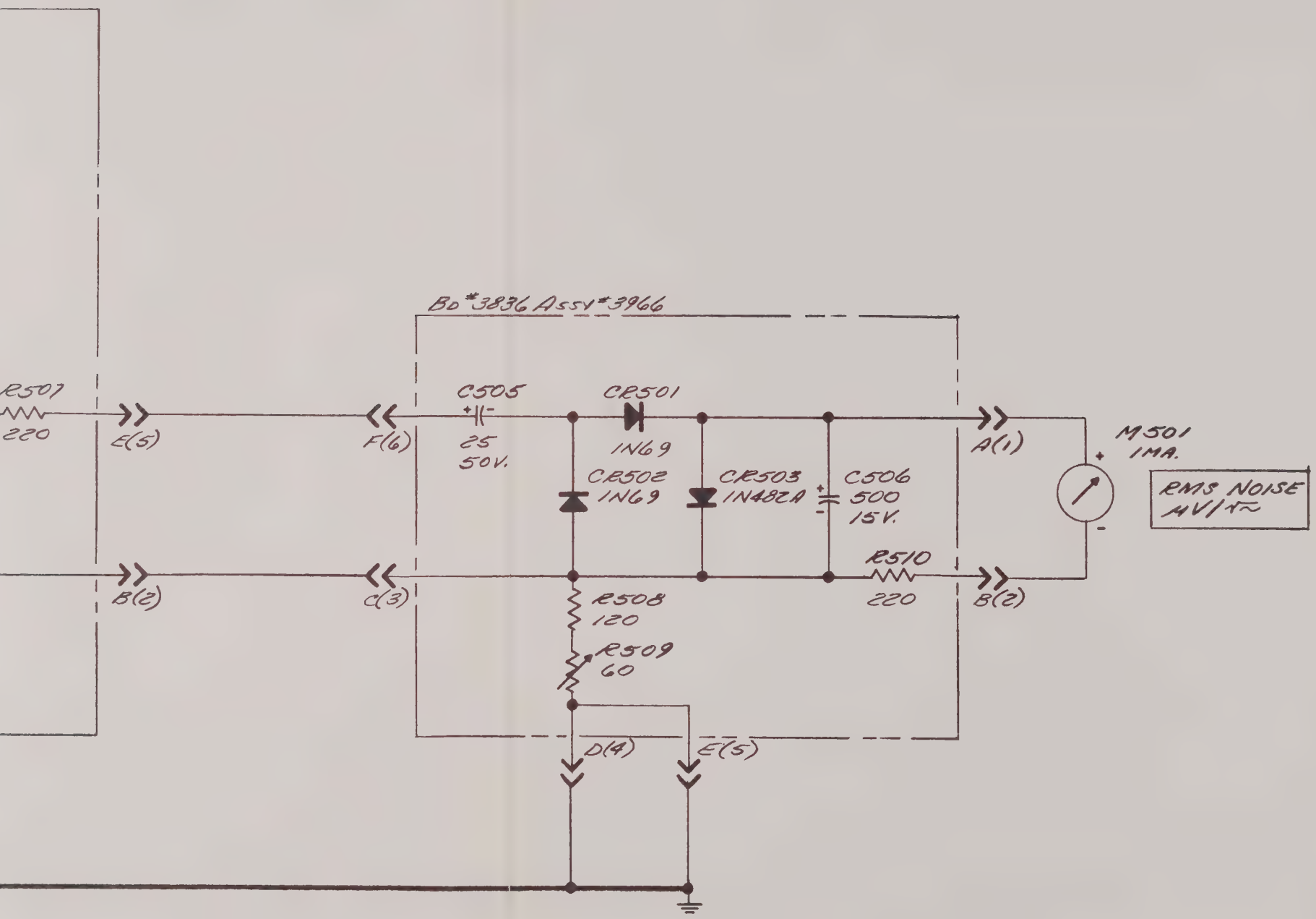
SCHEMATIC
500KC BUFFER
500KC OSCILLATOR
MODEL 420

T-3474-A

METER AMPLIFIER



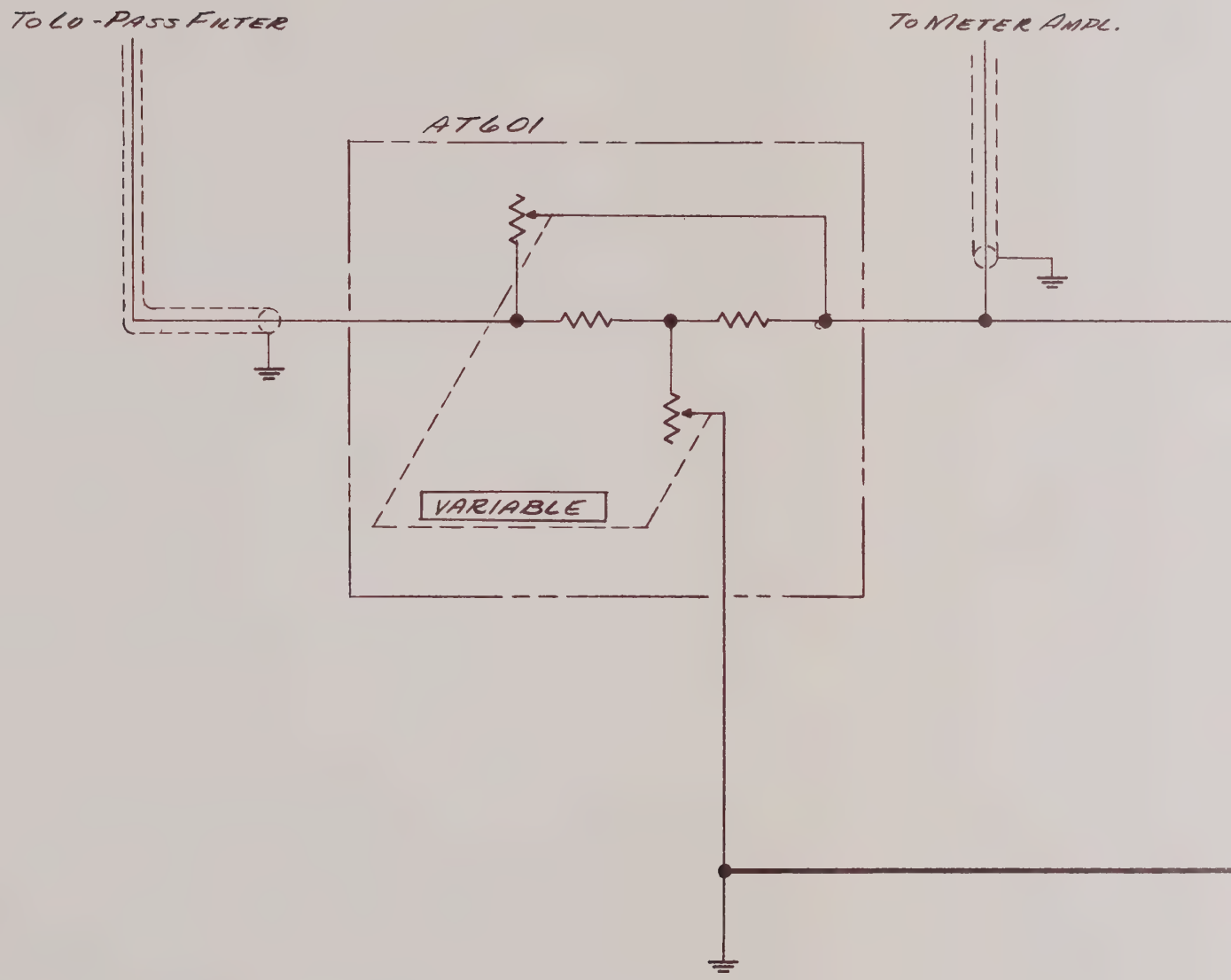
METER RECTIFIER



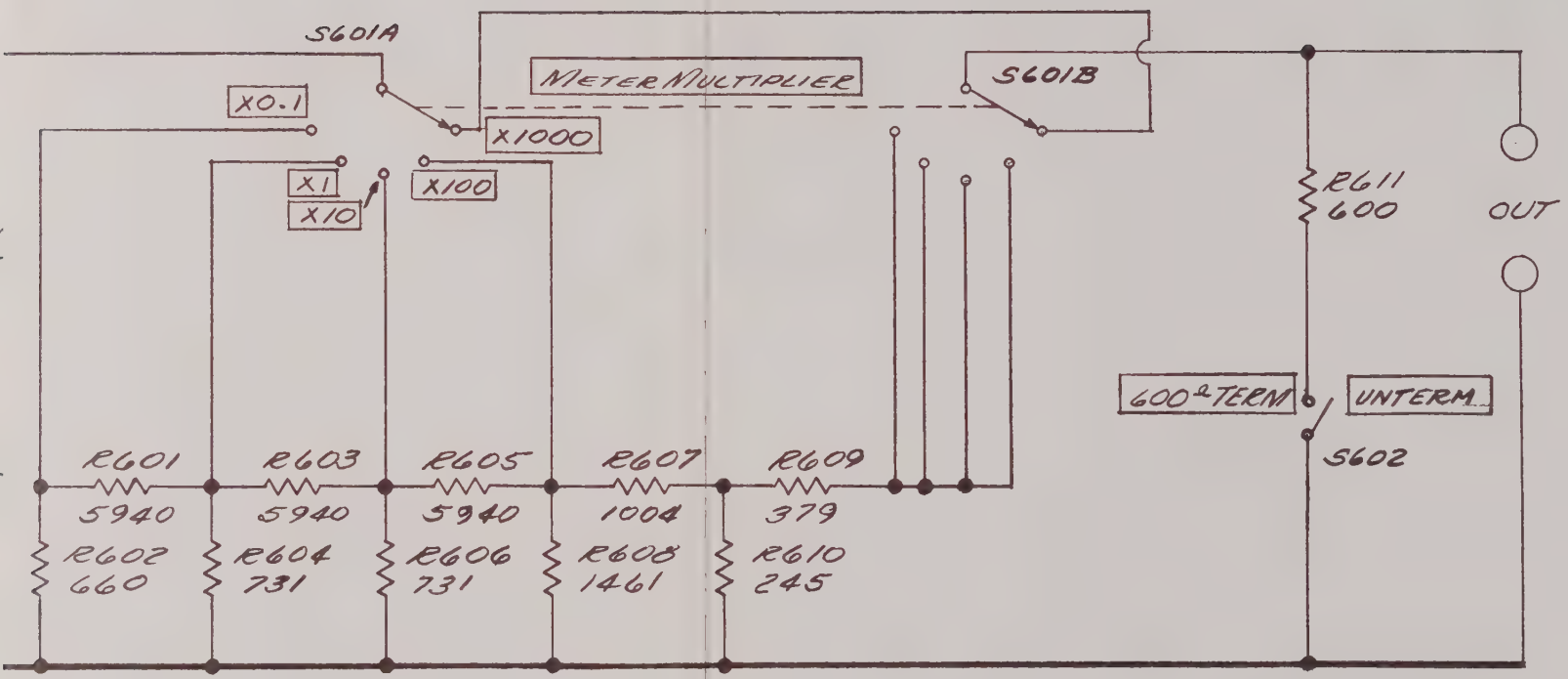
SCHEMATIC
METER AMPLIFIER
METER RECTIFIER
Model 420

T-3475-B

VARIABLE ATTENUATOR



STEP ATTENUATOR



SCHEMATIC
VARIABLE ATTENUATOR
STEP ATTENUATOR
MODEL 420

T-3476-A

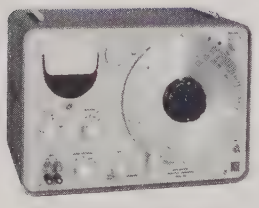
Short Form Catalog

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

Quan-Tech® GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

WAVE ANALYZERS



MODEL 303
WAVE AND NOISE SPECTRUM ANALYZER

Frequency range: 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μv to 300 v, FS. Down to 1 μv FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. Price: Upon request.

MODEL 304
LOW FREQUENCY WAVE & SPECTRUM ANALYZER

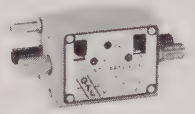
Frequency range: 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 μV to 100 v, FS; down to 3 μV FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

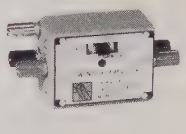
SOLID STATE AMPLIFIERS

MODEL 201B
DC DECADE AMPLIFIER
AC OR DC COUPLED



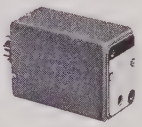
Bandwidth: DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110

MODEL 203
LOW NOISE AC AMPLIFIER

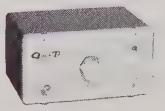


Bandwidth: 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. Battery powered; **Price:** $125

MODEL 205
HIGH-STABILITY DC AMPLIFIER



Bandwidth: dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 μv at constant ambient, input shorted. External + & — 12 v required. **Price:** $105



MODEL 206
SELECTABLE GAIN AC AMPLIFIER

Bandwidth: 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.

MODEL 301-B
E-I METER
SENSITIVE AC
VOLTMETER-MICROAMMETER

AC voltage range: .001 to 300V, FS. **AC current range:** .001 to 30 ma, FS. **Accuracy:** 2% voltage, 3% current, 20 cps to 0.5 Mc. Separate isolated current terminals. **Input impedance:** Voltmeter, 3 meg + 50 pf. Microammeter < 2.5 ohms + 10 μh. Completely transistorized. Price $305.

MODEL 1104 CLAMP-ON PROBE

0.1 ma to 3 amps FS. ± 5% 50 cps to 50 Kc
Price $65.

SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

Quan-Tech LABORATORIES, INC.

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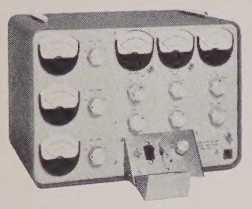
Quan-Tech®

NOISE INSTRUMENTS



MODEL 310 TRANSISTOR NOISE ANALYZER

Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as I_{cbo}, I_{ebo} and beta. **Noise voltage range:** 0.01 to 3 μv/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 μa for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.

MODEL 510 TRANSISTOR NOISE ANALYZER

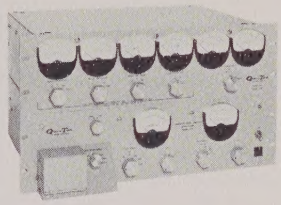
Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 μV/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $1095.

MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 μa. **Price:** $1145.

MODEL 512 TRANSISTOR NOISE ANALYZER

Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 μa to 1 ma. **Price:** $1145.



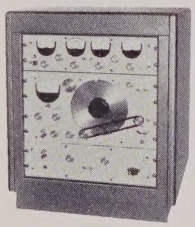
MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 μa to 30 ma. Also measures FET's. **Price:** $4950.

VERY LOW FREQUENCY NOISE ANALYZER

On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.

MODEL 2158 NOISE ANALYSIS SYSTEM



Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x 10^{-9} V and 2 x 10^{-12} A (100K input), 8 x 10^{-9} V and 6 x 10^{-14} A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

MODEL 315 RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.6 μv in a decade to 1000 μv in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300

MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 μv to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 μv/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

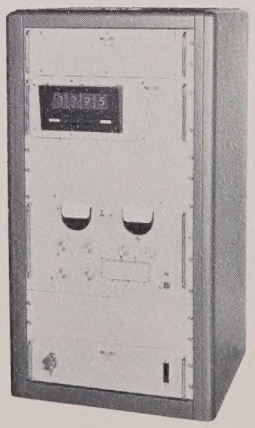
MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.



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A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

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